

# Pioneer F and G Mission Support Area

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*With the advent of the third-generation computer systems and the increased complexity of interplanetary missions, the area required to support mission operations has exceeded available facilities within the SFOF. Consequently, the Pioneer F Jupiter fly-by mission support area will be located in the new Systems Development Laboratory, Building 264. Following is a description of the mission support area, its relationship with the SFOF and other DSN facilities, and a brief discussion on some anticipated operational problems caused by its remote location from the SFOF.*

## I. Introduction

The SFOF has provided adequate facilities in support of numerous space missions beginning with the successful *Ranger 7* in 1964. By 1967, deep space missions reached their highest level of activity. At this time the SFOF supported four projects simultaneously, each with a separate mission support area.

The total floor space available for Project operations within the SFOF is 1263 m<sup>2</sup> (13,600 ft<sup>2</sup>). This area is arranged in a U-shape around the DSN operations and monitor areas on the first floor. During the second generation computer system it was adequate to provide individual mission support areas for *Mariners 4* and *5*, *Surveyors 1* through *7*, *Lunar Orbiters 1* through *5*, and *Pioneers 6* through *9*. Increased sophistication of spacecraft design has led to the implementation of the Mark III third-generation computer system. More personnel and equipment are required to handle the increased capa-

bility of the Mark III system. Accordingly, the size of mission support areas has also increased.

The *Mariner Mars 1971* mission is the most complex unmanned space mission ever undertaken. Orbital operations will demand the maximum capabilities of the Mark IIIA system. Consequently, a greater number of operational personnel will be required to insure mission success. As a result, the entire SFOF mission support area has been committed to the *Mariner Mars 1971* Project (Fig. 1).

The *Pioneer F* and *G* Jupiter fly-by missions have also increased in complexity from previous *Pioneer* missions. The *Pioneer F* Support Instrumentation Requirements Document specified a total of 855 m<sup>2</sup> (9200 ft<sup>2</sup>). To meet this requirement, the *Pioneer F* and *G* mission support area was located on the second floor of the systems development laboratory (SDL). This building is

linked to the SFOF by an 88-m (290 ft) long communications tunnel to provide all capabilities available in the SFOF.

## II. Design and Function of the Pioneer F Mission Support Area

The design of the mission support area (MSA) was a joint effort of the SFOF Operations Support Group (Section 916) and the *Pioneer* Project of the NASA Ames Research Center at Moffett Field, California. Original design utilized 855 m<sup>2</sup> (9200 ft<sup>2</sup>). However, budget limitations dictated a reduction in user equipment. This resulted in a redesign of the entire MSA. The final design is illustrated in Fig. 2. The total area utilized is just over 557 m<sup>2</sup> (6000 ft<sup>2</sup>). One of the guidelines followed in the final design was to utilize mission-independent concepts to prevent extensive modifications for future missions. The MSA is comprised of six major elements. They are:

- (1) *Mission Control*: Central control point for overall mission operations. Includes positions for the flight director and the chief of mission operations.
- (2) *Command*: One-man position responsible for actuating all spacecraft commands.
- (3) *Spacecraft Performance Analysis Team*: This group monitors spacecraft events and health. Positions include the spacecraft team leader, two assistants, and twelve operational positions for six spacecraft subsystems. Also included in this area are five positions for science control and monitoring. The major Science effort will be accomplished at the Remote Information Center at Ames Research Center.
- (4) *Software and Data*: This area does all the data processing for the Project. It interfaces directly with the IBM 360/75. It also provides a backup position for command.
- (5) *Orientation and Maneuver*: This group is responsible for the attitude control of the spacecraft. It is closely associated with the flight path analysis team.
- (6) *Flight Path Analysis Team*: Comprised of Division 39 personnel, but directly responsible to *Pioneer* mission control. This facility analyzes trajectories and ascertains parameters for midcourse trajectory corrections.

Major equipment in the MSA includes:

- 6 IBM 1443 line printers
- 2 IBM 2501 card readers
- 4 IBM 2260 digital input/output devices with keyboard
- 2 IBM 2260 digital output devices without keyboard
- 3 Gould digital television (DTV) hardcopy machines
- 16 Teletypewriter (TTY) character printers
- 1 Univac Data communications terminal (DCT) 500 printer
- 1 Univac Calcomp plotter
- 1 Univac 9300 terminal
- 2 Tektronix 4002 displays
- 44 23 cm (9 in.) TV monitors
- 11 36 cm (14 in.) TV monitors
- 18 58 cm (23 in.) Ceiling TV monitors
- 46 Voice Communications Assembly (VOCA) Stations

An office and conference area is provided for developing operational procedures and contingencies.

## III. MSA Interface With the SFOF

Additional equipment was required to extend the SFOF capabilities to the *Pioneer* MSA in the SDL. For support of the VOCA and TV subsystems, complete new terminal and switchgear frames had to be constructed in the SDL. This equipment is located in the northwest quadrant of the second floor. For the IBM devices, special line drivers (IBM 2944) were required to compensate for the distance of the MSA to the SFOF. All of the MSA equipment is linked with the SFOF through the 290-foot-long tunnel. The original tunnel design was meant to serve as a communications link and a personnel route as well. Again, budget limitations eliminated the latter. The tunnel is a hard hat area for installation and maintenance of cabling only. Any other use is not permitted.

## IV. Problem Areas Due to Remote Location

Undoubtedly, many operational problems will crop up during the testing and support phases of the *Pioneer F* MSA. It is anticipated that most of them will be minor, more or less an inconvenience rather than a serious problem. A good example is the maintenance of TV, VOCA, and IBM equipment. All maintenance shops, parts, and personnel are located in the SFOF. The carts for moving

items such as TV monitors or IBM 2260's cannot be used on the rough asphalt street. Also, the grade between the SFOF and SDL is fairly steep. These two factors could cause an accident resulting in equipment damage and/or personnel injury. The problem would be compounded by inclement weather. However, two problems exist which could impact *Pioneer* Mission Operations. One is purely from a support standpoint. The SDL building was funded through the NASA Office of Space Science Applications (OSSA) as an institutional facility. The SFOF and other DSN facilities are funded through the Office of Tracking and Data Acquisition (OTDA). SFOF plant maintenance is accomplished through a Tracking and Data Acquisition (TDA) contractor, Philco-Ford. These personnel will not perform plant maintenance in the SDL as it is an institutional facility. Therefore, all maintenance work must go through regular JPL Plant Maintenance channels. This could present a problem if any failures occur during high activity periods where rapid turn-around is required. It is anticipated that procedures can be arranged to minimize this problem. The second problem is more severe. Budget limitations did not permit extension of the uninterruptible power system from the SFOF to the SDL, or provision of any other backup power. If there is a power plant failure, the entire MSA

will be without power. At this time it is not known what a sudden power variation would do to the I/O equipment in the MSA, but the DSN is implementing an emergency MSA (Mini-Ops Area) in the SFOF. This facility is located in Room 102C adjacent to the DSN Operations Control Room (Fig. 1). Enough equipment is installed to support the major portions of the *Pioneer F* mission with emphasis on the command function. The *Pioneer* Project and DSN are developing procedures to assure mission success in spite of an SDL power failure.

## V. Conclusion

The *Pioneer F* and G MSA is designed for operational convenience. The area was designed to be mission independent. It will be used to support the *Helios* mission as presently configured. With minor modifications and addition of the northeast quadrant, the east half of the facility will be used for the *Viking* lander support. Presently, there is no major science support in the *Pioneer F* MSA. All science data will be routed via high speed data line to the Remote Information Center at Ames Research Center. All the principal investigators will be located at that facility.

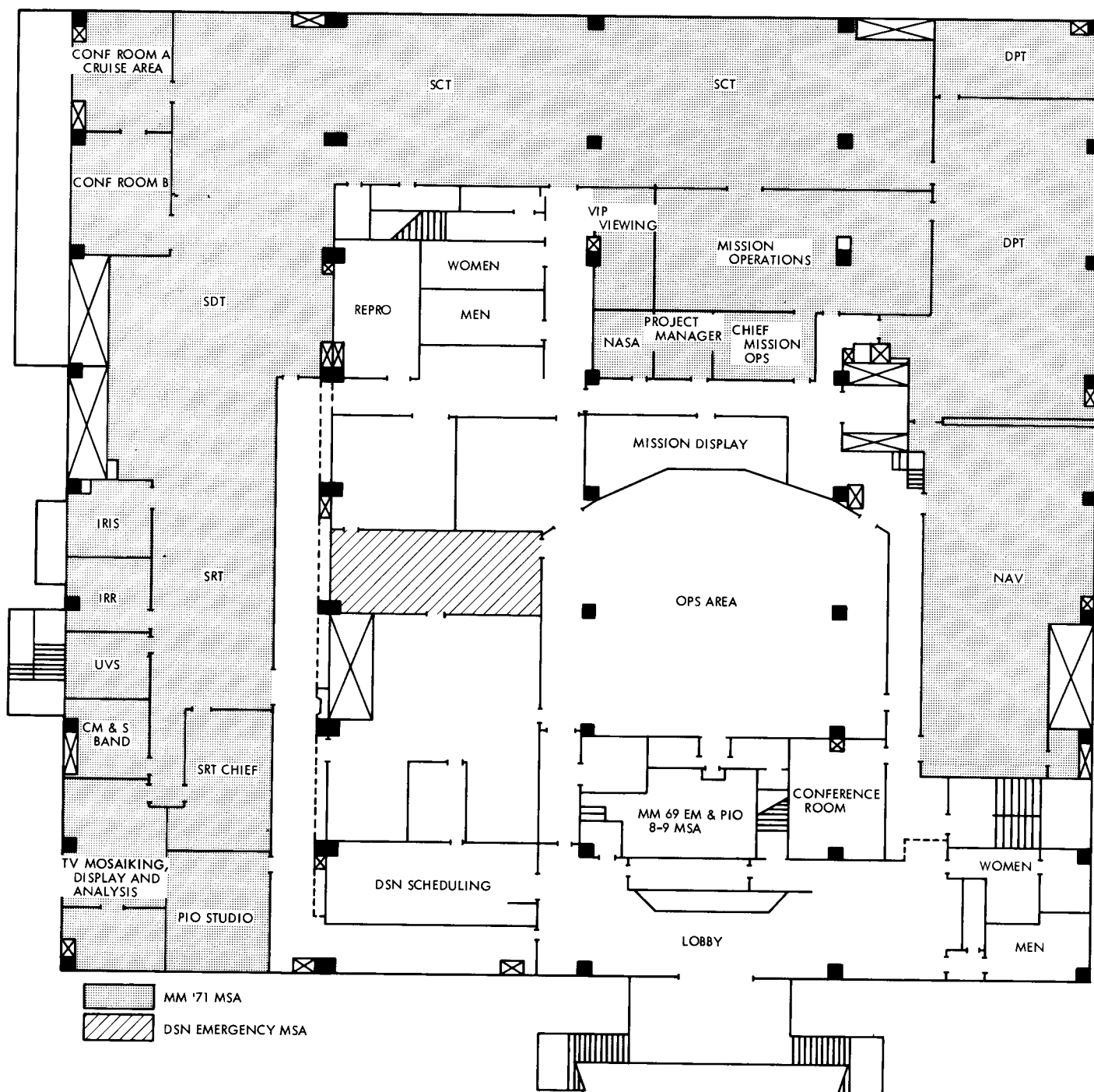


Fig. 1. SFOF first floor

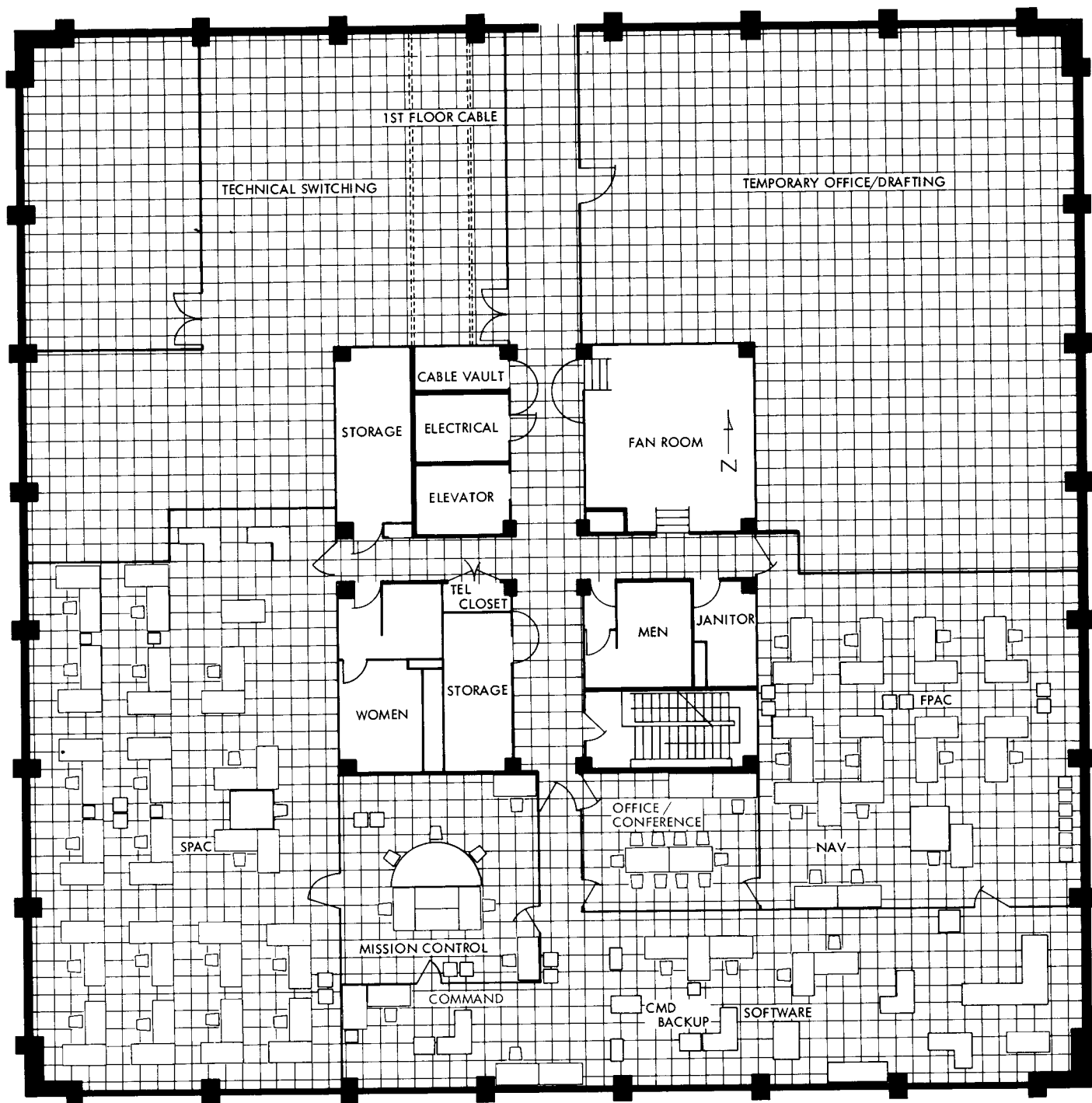


Fig. 2. Pioneer F and G mission support area